

Reimagining Higher Education Post-Pandemic: A Mobile Robotic Telepresence Case Study in the United States

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Abstract

Higher education is facing unprecedented challenges post-pandemic and must provide flexible and accessible learning options to students to remain relevant. This qualitative case study applied social presence theory to explore faculty and student experiences with mobile robotic telepresence (MRT) as tool for offering synchronous hybrid classes. Results indicated co-presence was the strongest element of social presence. Additionally, several key factors were identified for effective MRT implementation.

Keywords: *emerging learning technologies and accessibility, engagement or qualitative research*

1. Introduction

The pandemic had a profound impact on higher education and has forced a reexamination of the system (Kara, 2021). New strategic priorities include the use of emerging technologies to promote access, equity, persistence, interest, and focus (Kara, 2021; Kobysheva et al., 2021; Moshinski et al., 2021). Hybrid learning concepts have become prominent post-pandemic as the face-to-face vs. online binary has been rejected in favor of “convergence,” a synthesis of modalities (Brown, 2021, p. 3). One promising approach to integrate physical and remote learning spaces uses mobile robotic telepresence (MRT) to create synchronous hybrid classrooms (Bower et al., 2015). While MRTs have become increasingly accepted in business and healthcare settings, (Fitter et al., 2020; Sheehy & Green, 2011), there is limited research on their use in higher education (Capello, S. et al., 2022; Lei et al., 2019; Leoste et al., 2022). This study explores the use of MRT in a university setting and contributes to the understanding of the potential benefits and challenges of MRT in promoting effective synchronous hybrid learning environments in higher education.

2. Literature Review

The term telepresence is used to represent a variety of technologies that involve embodied, virtual presence in mediated environments (Hughes-Roberts et al., 2019). Research has shown MRTs to be effective in fostering accessible education, better communication, engagement, and social presence (Capello et al., 2022; Häfner et al., 2023; Kasuk & Virkus, 2024), but they have also presented technical, physical, and emotional challenges (Kasuk & Virkus, 2024). There is a need for additional research on the use of MRT in higher education to better understand its potential for offering effective synchronous hybrid learning environments and to promote positive benefits while mitigating challenges (Capello, S. et al., 2022; Lei et al., 2022; Leoste et al., 2022).

2.1. Social Presence

This study applied social presence theory. Social presence is an important factor in technology mediated communications because it has been associated with positive outcomes such as persuasion, trust and enjoyment, social influence, and attraction toward a physically embodied agent (Oh et al., 2018). However, there is limited consensus on the conceptualization and measurement of social presence (Almeida et al., 2022; Oh et al., 2018; Pimentel & Vinkers, 2021). For the purpose of this study, we characterize social presence across three domains: telepresence, self-presence, and co-presence. Telepresence is the extent to which one feels present in the mediated environment and is no longer aware that their experience is being mediated by technology (Almeida et al., 2022; Oh et al., 2018; Steuer, 1992; Vu et al., 2012). Self-presence is the extent to which the virtual self is experienced as the actual self and how the technology tool feels like and is treated like an extension of the body (Aymerich-Franch, L. et al., 2012; Biocca, 1997; Oh et al., 2018; Ratan & Hasler, 2009). Co-presence is the sense of being in the same place with another human, virtual or otherwise, and the perception of mutual entrainment with another (Almeida et al., 2022; Pimentel & Vinkers, 2021; Zhao, 2003).

3. Methods

The purpose of this qualitative study was to explore student and faculty experiences with an MRT pilot in a synchronous hybrid learning environment. The research question was: What are the experiences and perceptions of students and faculty who use robotic telepresence technology in a synchronous hybrid learning environment?

The study took place at a public university in the northeast region of the United States. The pilot used a four-foot VGo mobile telepresence robot with an integrated camera, microphone, and video display on a lightweight, motorized remote controlled platform. The MTR was made available to 24 faculty teaching across all programs in the satellite location after an initial training on the use of the MTR. In classes where the MTR was used, faculty, remote student

users, and local student users were sent open-ended surveys. Surveys asked for volunteers to participate in semi-structured interviews to gather more detailed information.

The robot was used in four different courses (two doctoral level courses, one masters level course, and one undergraduate course). Four faculty completed the survey and two were interviewed. Eight remote student users completed the survey and six were interviewed. Twenty local student users who interacted with the robot completed the survey and eight were interviewed. Data were analyzed through both inductive and deductive content analysis (Fereday & Muir-Cochrane, 2006). To promote trustworthiness of the data, collaborative coding (Saldaña, 2016) was used in conjunction with member-checking and data triangulation (Mertler, 2020).

4. Results

The feedback regarding the experience of telepresence among remote MRT users was mixed. The likelihood of the remote user experiencing telepresence seemed to be related to their level of expertise with technology, particularly video game usage, as well as the number of times they were able to use the MRT. The majority of participants agreed that MRT was preferable to video-conferencing. While some students experienced telepresence, were so distracted by trying to figure out how to use the robot, it made telepresence impossible.

Self-presence among the MRT users was also mixed with slightly more of the users applying language indicative of self-presence. While some participants experienced self-presence, others continued to refer to the robot as an external agent. More frequent use of the MTR seemed to lead to an increased sense of self-presence.

Co-presence was the strongest element of social presence with most faculty and students perceiving effective one-on-one and small group interactions. Two challenges that arose relative to co-presence were the ability to hear individuals when the whole class was talking and when wi-fi limited the ability to project the user's face on the screen.

Six additional themes related to the use of the MRT emerged in the data. First, the usefulness of the MRT was directly related to the pedagogical approach of the professor. Second, advanced preparation is required for MTR use to be successful. Third, both faculty and students reported the need for and benefit of additional support, such as a teaching assistant, when using MRT. Fourth, the robot was often a distraction, however, this seemed to dissipate with more consistent use. It was recommended that there be a student orientation that included an introduction to MRT and allowed students to practice with the robot. Fifth, maneuverability was a challenge for the remote user, but can be minimized with effective classroom set up and may improve as the robot technology continues to develop and improve. Finally, a strong wi-fi connection was

necessary for effective use of MRT and enhanced co-presence because it permitted the remote user's face to be present on the display.

5. Discussion and Conclusion

Higher education students have varied needs post-pandemic, with some wanting to return to face-to-face instruction, while others prefer the convenience of taking classes from home. To best serve all students, it is incumbent upon higher education institutions to find effective means of offering synchronous hybrid learning environments. This study explored faculty and student experiences with MRT and highlighted both the potential benefits and the inherent challenges associated with deploying telepresence technology in synchronous hybrid learning environments.

The findings of the study underscore the importance of aligning the use of MRTs with specific pedagogical strategies. The effectiveness of the MRTs and students' perceptions of social presence were influenced by the instructional approach adopted by educators. MRT was shown to be most useful when collaborative pedagogical strategies were employed, as opposed to lecture-based teaching, with co-presence being the strongest element of social presence. These findings are consistent with previous studies of MRT in higher education settings (Khadri, 2021; Lei et al., 2022; Leoste et al., 2022). Faculty and students would benefit from substantive training on the use of MRT, opportunities to observe the use of MRT in instructional settings, and the ability to practice with MRT in non-instructional settings before implementation. Faculty need to post class materials online ahead of the class and outcomes were improved with the use of a teaching assistant in synchronous hybrid learning environments. Previous studies have reported similar findings. (Botev & Rodríguez Lera, 2021; Kasuk & Virkus, 2024). A pedagogically sound deployment, pre-class preparations, faculty support, and familiarization with MRT functionalities enhanced student learning experiences.

Technical and operational challenges related to maneuverability and a wi-fi connections negatively impacted the learning experience and the degree to which the users experienced social presence. The MRT demonstrated potential for enhancing the telepresence and self-presence aspects of social presence only when users had sufficient preparation and practice using the MRT and there was sufficient wi-fi to support the technology. It is essential to address these operational and technical challenges through improved design and infrastructure support for the success of MRT applications in higher education.

The study illustrates the nuanced nature of social presence in MRT-mediated environments. While some participants experienced social presence and a sense of agency, consistent with the findings of Capello et al., 2022 and Fitter, 2020, others struggled to achieve similar levels of engagement. Future research should explore how different factors, such as individual technological proficiency and frequency of MRT use, contribute to the sense of social presence.

The mixed outcomes reported in this study suggest that while MRTs hold promise for enhancing hybrid synchronous learning environments, careful consideration must be given to both the technological and human factors involved. Educational institutions should consider the broader implications of MRT integration, including the need for policy and procedure development, infrastructure investment, and continuous evaluation of educational outcomes.

This study is subject to several limitations, including a small sample size, precluding generalizability. Furthermore, the data was collected from one university, which may not reflect broader educational contexts. The focus on the VGo mobile telepresence robot as the specific MRT under investigation could also limit the applicability of the findings to other telepresence technologies or platforms. Despite these limitations, the research offers valuable insights into the use of MTR technology in higher education, enriching the existing body of literature. The study offers potential benefits, or transferrable value, to higher education institutions seeking to increase enrollment and student satisfaction by offering synchronous hybrid learning environments (Mertler, 2020). Moreover, mobile robotic telepresence technologies, such as the VGo robot, offer promising solutions for bridging the gap in classroom access and participation for remote learners.

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